

C.O.L TECHNICAL SPECIFICATIONS

General

These specifications for traffic signal installations are intended to provide a minimum standard that shall be followed when traffic signal work is done for the City of Longmont. These specifications shall apply to all materials supplied and methods and procedures of work to be followed.

The technical specifications outlined in this document are revisions and amendments to the Colorado Department of Transportation (CDOT) Standard Specifications for Road and Bridge Construction. In situations where there is a conflict or question of interpretation, these specifications and any special conditions will prevail.

Construction of traffic signal systems shall be done in accordance with the City of Longmont (C.O.L.) Traffic Signal Standards and Specifications, the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD) for Streets and Highways, the latest revision of the Colorado Supplement to MUTCD thereto, and traffic signal plans and details.

Any materials or equipment supplied by the contractor shall be from the City of Longmont's Traffic Signal Approved Materials list. If the contractor does need to supply various items that are not listed on the City of Longmont's Approved Traffic Signal Materials List, the contractor shall get approval first from Traffic Signal Operations staff before providing / installing the item or equipment.

The Contractor shall have an I.M.S.A certified Level II or Level III Signal Technician on the job site when:

- any conduit is to be trenched, or pushed and placed,
- any wiring is to be placed or connected,
- any traffic signal components or cabinets are being placed or wired.

All work within cabinets, and/or work done when responding to a malfunction or flash issue, shall only be performed by a certified I.M.S.A. Level II or Level III Signal Technician whom possesses the ability to analyze, troubleshoot and make appropriate repairs if a problem arises during the work they are performing.

All traffic signal equipment shown on drawings are approximate and shown as schematic only; exact locations shall be determined and located as per individual project details.

Whenever the contractor is working at a signal in Longmont, they shall first contact the Senior Traffic Signal Technician/II to provide work locations and a brief description of work being performed for the day.

When a contractor is installing signal equipment such as signal heads/pedestrian heads, pushbuttons, cameras, Opticom, signs and street light arms, they shall contact the Senior Traffic Signal Technician/II approximately (2) days in advance to request placement and/or location of the equipment

Contractor performing the traffic signal work shall provide an as built drawing showing the details and placement/locations of the; conduit runs-- quantities/sizes, and conductors in each, cabinet, signal heads, cameras, Opticom, pull boxes and loops & valves if installed.

All traffic signal work shall be inspected by the Senior Traffic Signal Technician/II.

It shall be the contractor's responsibility to test and check for proper operation of any aspect of the operation of the traffic signal as they perform work on the signal. This pertains to any installations, upgrades, re-builds, or modifications to ensure proper function before they leave the work site. If for any reason the Contractor is unable to ensure this, the Contractor shall notify the Senior Signal Technician/II of outstanding issues so that they can respond and assist either in the field or over the phone to resolve the problem before the contractor leaves the site.

When contractor is installing a new signal, partial re-build, and or upgrade they shall contact the Traffic Signal Operations to request a preliminary inspection prior to the switch or turn on. If any items are found to be insufficient, then the contractor shall correct them before the final switch or turn on. On the day of the switch or turn on Signal Operations shall be on site to ensure all aspects of the signal are ready for operation.

Conditions of Materials Furnished

All items furnished shall be new, in proper working order. Prior to ordering materials, the Contractor shall submit a list for approval to the Senior Traffic Signal Technician. The list shall show all equipment and materials that is proposed to be installed. Each item shall be identified by the trade name, size and catalog number. Smaller incidental items shall be new.

Excavating and Backfilling

Excavation and backfill shall comply with the applicable sections of the City of Longmont Design Standards and Construction Specifications and as described on these specifications as per item detail.

Signal Cabinet & Base removal, concrete or fiberglass any size (1,2)

Removal consists of removing signal cabinet and base either fiberglass or concrete. Existing wiring shall be pulled back into pull box and protected. Remove existing rock and ground rod if fiberglass. Break down, remove and dispose of broken concrete from base if concrete. Existing conduit into base shall be cut off or removed approximately 3' to 5' away from base as per Senior Signal Technician/II. Area shall be restored to match existing surroundings.

Cabinet removal and re-install new or used cabinet (any size) (3)

Removal of old or damaged cabinet off existing base. Install new cabinet on existing base, consists of disconnecting of wiring, removing the base, cabinet, bolts, removing all standalone equipment/components from cabinet, and removing the cabinet. Then set new cabinet on base, re-install base, bolts (new), hook-up wiring arranged in an organized separated manner with no crisscrossing / tangling / intertwined wires or cables ensuring all wiring is securely connected to the terminals. Re-install all standalone components/equipment back to their appropriate positions while securely connecting all to cables. Then test cabinet by a bump out test to ensure wiring is hooked back up in proper order and have approval while Signal Ops is on site for turn on. Bases shall be caulked with a clear silicon sealant after placing cabinet on base. Transport of cabinets is inclusive of line item charges.

Cabinet Install (4)

Transport cabinet to site, place cabinet on base, caulk base with a clear silicon sealant, and install new base bolts that are no smaller than ½” with washer and nuts. Hook-up wiring arranged in an organized separated manner with no crisscrossing / tangling / intertwined wires or cables’ ensuring all wiring is securely connected to the terminals. Re-install all standalone components/equipment back to their appropriate positions while securely connecting all to cables. Then test cabinet by a bump out test to ensure wiring is hooked back up in proper order and have approval while Signal Ops is on site for turn on.

Removal and Re-Install of Fiberglass Cabinet Base (any size) (5)

Removal of the cabinet base includes removal of a damaged base and or just a removal to exchange for a different size. Intention of this removal is for some type of replacement fiberglass base. If it is damaged then it will be disposed of by contractor. If the fiberglass base is not damaged then it shall be directed by the Senior Traffic Signal Technician/II as to where to deliver the base. The existing ¾” rock will be removed and set aside and then re-installed after new base is in place. Install new base in existing location of removed base. Rock shall be added if necessary to meet our specification.

Installation of Fiberglass Cabinet Base (any size) (6)

Install fiberglass base in ground with 15” above surrounding grade level of dirt, sod/landscape or concrete. If base is being installed in active construction area then contractor is responsible to find out what final grade will be so they can set base proper according to the finished grade level. 8’ ground rod shall be installed into ground and end up 2” below top of fiberglass base towards right side of base. Fiberglass base shall be filled with ¾” crushed rock to 2-3” below conduit tops.

F/I Cabinet Step Pad (M or P size)

(7)

A step pad will be included with every cabinet base installed with the exception of when a cabinet base is set up against a sidewalk which that serves as the step pad. The concrete to be used will be specified per project by the Senior Traffic Signal Tech/II. It will be either Sack Crete w/Portland added or left over or extra concrete from possible caisson pours. Size of step pad shall be the same width as the face of the base by 30" deep by 4" thick and placed adjacent to and in front of base/cabinet. Top of new pad shall be 2" to 3" above dirt or sod so that grass, weeds won't grow and cover up pad. Concrete shall be finished with brushed top and rounded edges.

Install C.O.L. Standard Bollard in Dirt / Landscaping or Concrete

(9,10)

Bollard detail – 4" X 7' SCH40 steel Bollard filled w/concrete with yellow plastic cover to sleeve 4' – 5' over top portion of bollard, (no primer or paint) Note: 4" SCH40 pipe has an outside diameter of 4.5" and with plastic outside cover the diameter is approx. 4.95".

Dirt or Landscaping install - Caisson shall be installed at 2' diameter by 4' deep. No cage is necessary. Bollard shall be installed at a minimum of 4' below ground and 3' above ground.

Concrete Install - Caisson shall be installed at 18" diameter by 4'6" deep. Bollard shall be installed at a minimum of 4' below ground and 3' above ground. A 12" cage shall be used along with a schedule 40 steel sleeve with a 5" I.D. for bollard to slide into. There shall be caulking applied on top of sleeve between bollard and sleeve to protect from debris. Also there shall be 6" of ¾" crushed rock at the bottom of the caisson for drainage purposes, bollard shall rest on the crushed rock. The top of the concrete caisson shall match existing grade and be finished with a brushed top to look professional.

Please call Traffic Signal Operations if you need to install bollards; they will supply you with the current details/drawing and installation standard needed. Install as shown on plans or as directed by the Senior Traffic Signal Technician/II.

Removal of Pedestal Pole w/T-Base

(11,12,13)

First remove any attached equipment, and then remove pedestal pole and t-base. It will be determined by Senior Signal Tech/II whether or not ped pole and or equipment will be re-used, returned to the traffic signal shop and or disposed of. Contractor is responsible for disposal.

Ped Pole Foundation Removal

(14)

Remove the entire caisson if possible, but if for some reason this is not able to be accomplished then the caisson will be knocked down 2' below dirt grade. After removal re-use the dirt and add additional if necessary and put back into void and compact to 90 percent compaction. Area shall be restored back to original landscape and or concrete/asphalt; the method will be determined by Senior Signal Technician/II.

Ped Pole and T-Base Install on Existing Foundation 3'-18' (15)

To install the Ped pole and base requires putting together the pole and the T-base, then securing them to the anchor bolts on the foundation. Ensure the pole is level and straight, if necessary steel shims or (washers) may be required to accomplish proper leveling. Some rare cases grout shall be required as per Senior Signal Technician/II.

Ped Pole and T- Base Install, F/I Foundation (16)

Refer to above Ped Pole and T-Base Install for install of pole and T-base. Foundations for the Pelco Pedestal Pole/T-Base shall be built with the proper anchor bolt circle necessary for a complete installation, and shall be a minimum of 2' diam. X 4' in depth. Each pedestal pole foundation shall require the contractor to install (1) – 2" PVC conduit from 3" above top of foundation to approximately 2' down in concrete foundation and come outside the foundation 3" for conduit extension to go to pull box location. In special circumstances it may be necessary to alter the depth of caisson due to utilities and will be determined by Senior Traffic Signal Technician/II in the field. Pedestal poles foundations will be concrete as per the City of Longmont design standards and construction specifications. Pedestal poles shall not be erected until the foundation concrete has set at least two days.

Fiberglass Pole 14' – 25' Install w/ foam filler (17)

The installation of the pole will require the hole to be 18" diameter by 4' in depth. It shall include installation of (2) part expanding foam (supplied by contractor) filler around the base of the pole in the ground to stabilize the pole so it will not allow the pole to lean or tilt over time. The surrounding ground that is disturbed by the installation shall be restored to match existing landscape.

Rake/Align Signal Pole (18)

Using the anchor bolts/nuts and base of pole adjust them up or down to bring the pole into proper alignment. Contractor shall call the Senior Traffic Signal Tech/II after the raking is completed to get approval and confirm the alignment is what was requested. Contractor shall install grout around base as necessary after approval of alignment is accepted.

F/I 10" – 12" Pole and Foundation in Dirt or Concrete for Temp. Span Wire & Install of Span Wire and Tether Cable (19,20,21,22,23)

Span wire poles, foundations, span wire, appropriate size weather head, and tether cable shall be installed as per CDOT standards. Senior Traffic Signal Technician/II will provide placement of the signal heads, Opticom, and signs to contractor.

F/I Temporary Span Wire Signal Head (3, 4, 5 section) and Mounting Hardware (62,63,64)

Contractor shall furnish and install signal heads as needed on a temporary span wire using the appropriate mounting hardware. When the temp span is removed the signal heads, mounting hardware, span wire and tether etc. is the property of the Contractor.

Removal of the Span Wire Pole (any size) and Foundation (24)

The removal of span wire pole and foundation shall include the removal of the pole, wiring shall be removed back to pull box. Any conduits that were attached to pole or into pole base shall be cut back or removed to pull box. Removal of a minimum of three feet of the concrete foundation below the surface grade, if a concrete foundation was used and backfill the hole to a minimum compaction of 95% and restore to original landscape and or concrete/asphalt. The contractor shall then dispose of and or deliver the poles to a location designated by Senior Traffic Signal Technician/II.

Removal of a Span Wire & Tether Cable (25)

Removal of the span wire, tether cable shall include disconnect and removal of the signal heads, wire and other related signal equipment that is attached to the span wire. Any signal equipment that belongs to the City shall be returned to the Traffic Signal Shop in good condition. Otherwise disposal of unwanted materials or items shall be the contractor's responsibility as per Senior Traffic Signal Technician/II.

Signal Pole, Street Light Pole &/or Mast Arm Removals (26,27,28,35,37,38,39)

The removal of a mast arm and or signal pole shall consist of removal of the arm including any signal heads, brackets, cable/wire, video cameras, Opticom sensors and signs. The removal of a signal pole shall consist of removal of the pole including any signal heads, brackets, wire/cables, pushbuttons, signs, street light arm/luminaries etc. Equipment shall be either disposed of by contractor and or return undamaged to the City Signal Shop or other location as designated by the Senior Traffic Signal Technician/II.

Signal Pole, Extension or Streetlight Pole, &/or Mast Arm Install (29,30,31,32,33,34,36,56)

Install the signal pole, extension/street light pole on a concrete foundation. If streetlight arm/luminaries are being called for, then their installation is considered part of the pole installation task. Signal poles shall be installed with the proper rake, to assure a substantially vertical set when the specified signal and lighting equipment is installed. Mast arms shall be installed with the correct top side on top to ensure the proper angle for the load of equipment on arm. Plumbing the pole shall be accomplished by adjusting the nuts before the foundation is finished to final grade. Shims or other similar devices for plumbing or raking will be permitted only when approved by the Senior Traffic Signal Technician/II. Neither chains nor cables will be used for unloading or installing poles/arms. Poles shall have grout placed between the base and foundation. Senior Traffic Signal Tech/II will give contractor the streetlight arm angle.

Signal Pole Caisson Removal (any size) (40)

Removal of a signal pole foundation shall consist of removal of caisson, anchor bolts, conduit and cage to a depth of 2' below dirt grade. After removal only dirt shall be put back into void and compacted then restored back to original landscape and or concrete/asphalt, It is also required that if any of the conduits that were in the foundation that is being removed are not going to be intercepted/re-used again then the contractor shall open up the pull box next to the pole and remove the unused old conduit. Contractor shall remove and dispose of all concrete, conduit, iron and bolts from caisson.

Install Signal Pole Foundation / Caisson (Vac drilled only use of Drill rig can used in certain situations but must get approval from Senior signal tech at no additional cost to establish required depth) (41-55)

Concrete caisson / foundations for both C.O.L. and CDOT shall be cement concrete conforming to the applicable requirements of section 601 of the State's Standard Specifications for Road and Bridge Construction. Each project will specify on the plans the details of pole and caisson/foundation specifications that will need to be used.

On all state highway owned roads the Signal Pole caisson/foundation shall be the CDOT Standard Specification S-614-40 when using any double mast arms (any length) and or single mast arm applications greater than 55' in length. The specification S-614-40- A will be used for all single mast arm applications 55' in length and under.

On all City of Longmont (C.O.L) owned roads the caisson/foundation shall be the City of Longmont Standard Pole caisson/foundation drawing # M07213SIG01.DWG.

Signal Poles shall not be erected until the caisson / foundation concrete has set at least seven days. Caisson / foundations for high strain poles shall set a minimum of ten days. If a high early grade of concrete is used, set time will be determined by the Senior Traffic Signal Technician/II or Project Engineer based on the concrete mix design.

On any of the caisson/foundation installs it is imperative that the contractor understands and meets the specification for the anchor bolt projection as per C.O.L. and CDOT.

NOTE: On any C.O.L. caisson the contractor when installing the anchor bolts shall attach (5 or 7) stirrups spaced evenly around the outside of the anchor bolts depending on what caisson is being used for the required pole/arm to keep the anchor bolt pattern consistent throughout the caisson. It shall be the responsibility of the contractor to verify and ensure that the anchor bolt pattern is correct with the design standard for each particular pole installation; i.e., when a template is supplied, the contractor shall measure the bolt circle dimensions to ensure they match the pole/arm to be installed. Additionally, when a template is not supplied the contractor will need to ensure the bolt pattern they make is to the correct dimensions for that

pole/arm size. This shall be confirmed and verified prior to installation. Contractor shall acquire the final grade so they can determine the proper height for the caisson and anchor bolts to be set so caisson/pole will end up correct grade level. If the base of the pole does not match the grade of the sidewalk it may be necessary to fill the void between the base of the pole and the walk by use of a sand based grout not concrete; this situation should be avoided if at all possible.

The provisions in the above paragraph are general descriptions for normal roadway conditions. In certain cases special foundation requirements may be necessary and will then be specified on plans or by the Senior Traffic Signal Technician/II. For example, where heavy excavations, embankments, sloping (rip-rap) areas near the roadway or unusual soil conditions are encountered.

Each signal pole caisson shall require the contractor to install (2) – 3" PVC conduit from (1) foot above top of caisson to approximately (2) foot down in concrete caisson and come outside the caisson 3"-5" for conduit extension that will go to pull box location.

It shall be noted, although not always encountered when digging for the caisson, if water is found then it shall be removed down to approximately 3" before the concrete is to be poured. If the water level cannot be removed to this level the contractor may need to use a proper trimmy system to ensure the integrity / strength is not jeopardized by the water mixing in as it is poured, this is a serious condition and if it is not done properly then the Senior Traffic Signal Tech/II and or City Inspector will not accept the caisson. If the trimmy system is used then the contractor will have to have a way to dispose of the water that comes off the caisson properly. Water is not allowed to disperse on the ground needs to be hauled away or approval to use a silt filter bag.

If a condition arises that contractor wants to install a caisson casing this must be approved by COL prior to install. There may be an alternative method that can be considered.

Contractor shall be prepared with all necessary materials and equipment on site when installing a caisson so they can be ready for all potential different conditions that may occur, there will not be additional charges allowed to re-mobilize equipment/materials if they come unprepared for completion of task.

If the diameter of the caisson hole is enlarging beyond the appropriate diameter it may be necessary for the contractor to install 3'-5' of sono-tube to keep the diameter size of the caisson to the standard. In the instances this is deemed necessary the contractor shall then fill in the void area between the sono-tube and the ground with either flow fill and or dirt to a 95% compaction. This will be considered incidental to the caisson install.

City of Longmont's standard to install a signal pole foundation is now to use the safe method of vacuuming out the hole for the signal pole foundation. When vacuum digging, this shall be inclusive of the removal and disposal of the water/mud/debris.

There may be occasions where COL will approve the drilling method of installing a caisson, but only when approve first by COL.

If unusual circumstances are encountered it is the contractors responsibility to notify Senior Traffic Signal Tech/II and or Project Engineer immediately as to the problem and if they have a potential solution of a revision on the caisson by acquiring a Licensed Professional Engineer to sign off on the adjustment with a written stamped approval, then this may be considered. Also if at any time due to problems incurred by contractor on the installation of the caisson and the concrete in the concrete truck goes beyond the 90 minute time frame as it is standing by waiting in the truck and ends up being unusable and has to be turned away this is at the contractors expense.

It shall be the contractor's responsibility to remove any dirt/spoils from site when installing any caissons. This shall be inclusive of the caisson install. The surrounding area shall be restored to prior condition. The project work area shall be cleaned up and left in good condition.

Contractor shall give the City of Longmont Senior Traffic Signal Technician/II a prior days' notice for a time as to when a caisson pour is scheduled, so COL can be on site to inspect and approve before the pour and then observe the concrete pour, along with the aiming of the anchor bolts in each caisson. If any issues arise that are a concern on the caisson then contractor shall make the adjustments as necessary prior to pour of caisson.

Small Cabinet Removal and Install

(57,58,59)

Removal -- requires disconnecting wiring, and small cabinet to be removed off pole with mounting hardware and wire entrance fittings. If this is a permanent removal this will also require the wiring to be disconnected and removed from its power source, then it shall be necessary to plug or fill holes on pole left from removal of cabinet.

Install – Consists of installation of the cabinet and mounting hardware. The entrance of the wiring going into each cabinet shall be from the bottom. The application of the installation will be determined by the Senior Signal Technician/II. If it is determined a service entrance elbow i.e.: (LB) will be used, then the contractor shall supply the needed 1 ½ inch aluminum (LB) and the miscellaneous parts for the installation. Caulking shall be used to seal off any openings around mounting hardware to keep out moisture and insects. On all installs, the Senior Signal Technician/II will instruct the contractor where caulking sealant needs to be applied as all installations can vary a bit.

Pedestrian Head Removal and/or Install

(60,61)

Permanent Removal -- disconnect and remove wiring in ped head to pull box, details will be given as per Senior Signal Technician/II. Remove the head/s and return it undamaged to the City Signal Shop. If there is no replacement head then the hole in the pole shall be filled with an appropriate epoxy filler to cover the hole leaving a smooth finish, and or if the hole is of a size

that a box plug can be installed this application requires a ½" or ¾" NPT tap, this is the preferred way to fill the hole.

Install -- shall include drilling of hole in pole at 8'9" thus allowing the bottom of ped head to be at 8', mounting head on pole using ½" bandit/buckles in designated location on pole for proper aim and angle towards the opposing crosswalk in which pedestrians are crossing the street towards the ped head, this will mean to appropriately drill the hole in the pole to fit centered in the clamshell bracket, which at times may not be square to the intersection. Connect wiring.

Removal and Replacement -- disconnect wiring in ped head, remove ped head off pole then install new ped head using ½" bandit/buckles, then reconnect existing wiring. Remove the LED out of the old ped head and install it in the new ped head, use existing female slip connectors on ped LED wiring to connect to ped head terminals. Contractor shall aim and angle the ped head towards the opposing crosswalk in which the pedestrians are crossing the street towards the ped head, this will mean to appropriately drill the hole in the pole to fit centered in the clamshell bracket, which at times may not be square to the intersection.

**Signal Head, Mounting Hardware and Wire Removal (any size) – Overhead or SOP
(65,71)**

For permanent removal requires signal head, mounting hardware and wiring be removed, and wire shall be removed back to pole base and or pull box. The hole in the pole shall be filled with an appropriate epoxy filler to cover the hole leaving a smooth finish, and or if the hole is of a size that a box plug can be installed this application requires a ½" or ¾" NPT tap, this is the preferred way to fill the hole. Signal head and mounting bracket shall be returned back to the Traffic Signal Shop or disposed of by contractor as per directed by the Senior Traffic Signal Tech./II.

School Flasher / Warning Flasher (1) section removal and/or install (66,67,73)

Removal – disconnect wiring, remove signal head section, wiring and mounting bracket, plug hole as needed.

Install – drill hole as directed as per Senior Signal Tech/II, install mounting bracket and signal head section, connect appropriate wiring in head.

Signal Head and Mounting Hardware Install (68,69,72)

Install mounting bracket(s) on arm or pole in proper location, then install signal head on bracket/s, aim signal head appropriately to the designated lane it is controlling, then connect wiring.

Signal Head and Mounting Hardware Reset (70)

Disconnect and remove the existing signal head and mounting bracket, drill new hole in new location on arm or pole then install either the old or new mounting hardware in new position. Using either the existing wiring and or new, the wire will need to be reconnected in signal head that is reset on bracket in new location.

Astro/Sky brac assembly Removal and Install (all sizes) (74)

This is primarily to change out a broken astro/sky brac clamp and replace with a new clamp, this does include the removal and install of signal head/sign that's existing on mounting bracket.

Signal Head removal and install on Existing Bracket (overhead) (75)

For a signal head on a astro/sky bracket disconnect wiring and remove signal head attached to the lower and upper arms/ post as a whole, from the astro/sky brac clamp, then install the new signal head with the new arms/post assy. on the existing astro/sky brac clamp, and connect to existing wiring. As part of this task it may be required at times that there will be splicing changes necessary in pull boxes and or cabinet to enable the signal to operate properly and will be considered incidental to the task.

Signal Head Modification Minor (overhead) (76)

Modification on an existing signal head shall be disconnecting and removing a (2) section off of a (5) section 2-way variable astro/sky brac then changing the LEDs in the remaining (3) section. Or a similar small modification. As part of this task there will be splicing changes necessary in pull boxes and or cabinet to enable the signal to operate properly and will be considered incidental to the task.

Signal Head Modification (SOP) (77)

Modification will consist of disconnecting wiring in signal head, then either adding or removing signal sections, this requires removing the upper side of pole ell bracket and re-installing it at new position for head re-install. LEDs may need to be changed out depending on what signal indications are necessary. Reconnect wiring as directed in COL traffic signal technical specifications in signal head. As part of this task there will be splicing changes necessary in pull boxes and or cabinet to enable the signal to operate properly and will be considered incidental to the task.

Removal of Astro/Sky Brac & Signal Head & Install SOP Ells (SOP) (78)

Disconnect and remove the signal head and astro brac clamp mounting hardware, remove astro arms/post off of signal head, drill new hole location at 10' in pole for SOP lower ell location and redirect existing wire into new hole location, install lower SOP ell using the ½" bandit/buckles to pole then install signal head on lower ell bracket, install upper ell bracket and re-connect wiring. The hole in the pole left from removal of astro brac clamp shall be filled with an appropriate epoxy filler to cover the hole leaving a smooth finish, and or if the hole is of a size

that a box plug can be installed this application requires a ½" or ¾" NPT tap, this is the preferred way to fill the hole.

Remove and Install of Back Plates (79,80,81,82)

The removal of a back plate will be for the purpose of replacing a damaged back plate on an existing signal head. Installation of a back plate may be for the addition of a new back plate to an existing signal head.

Signal LED Removal and Replacement (in existing head in field) (83)

This is for the purpose of replacing a bad LED, either Overhead or SOP.

Ped LED Removal and Replacement (in existing head in field) (84)

This is for the purpose of replacing a bad Ped LED.

Opticom Sensor Removal and Install (85,86,240)

Removal -- If permanent removal it shall include opticom sensor, mounting bracket, wire and then plug hole left from removal of mounting bracket, it shall be filled with an appropriate epoxy filler to cover the hole leaving a smooth finish, and or if the hole is of a size that a box plug can be installed this application requires a ½" or ¾" NPT tap, this is the preferred way to fill the hole.

Install -- Shall consist of drilling a hole in arm, installing mounting bracket and sensor unit then hooking up wiring to unit. The contractor shall run a field test to ensure the proper operation and range for the new unit, contact the Senior Signal Technician/II to be on site for this test to confirm it is acceptable.

Removal and replacement -- Remove opticom sensor and replace with a new/existing sensor, after the unit is wired back in the contractor shall run a field test to ensure the proper operation and range for the new unit, contact the Senior Signal Technician/II to be on site for this test to confirm it is acceptable.

Pushbutton Removal and/or Install (87,90,93,94)

Removal -- If permanent removal it shall include removal of the pushbutton, wire and the pushbutton sticker off the pole, then plug hole left from removal, it shall be filled with an appropriate epoxy filler to cover the hole leaving a smooth finish, and or if the hole is of a size that a box plug can be installed this application requires a ½" or ¾" NPT tap, this is the preferred way to fill the hole.

Install -- Shall consist of drilling a hole in the appropriate place @ 42" up from ground level on pole, then install the pushbutton base, pushbutton, hook up wiring and test. Place pushbutton sticker on pole above the button.

Removal and replacement -- remove the front pushbutton section and or base section or both when needed. Install new part that is needed and re-use what is still good, hook up wiring and test. If needed place new pushbutton sticker on pole above the button.

Adaptor replacement and or base only – requires removing the front section of the pushbutton first, then remove damaged adaptor piece and replace with either a new adaptor or the newer metal base piece which if this is the replacement then the old base is removed and the new metal base goes on the pole, essentially makes the pushbutton (2) pieces not (3).

APS unit &/or Circuit Board, wire & sticker Removal / Install (88,89,91,92)

Permanent Removal -- consists of disconnecting wiring in both the APS unit on the pole and then the circuit board in the ped head, remove the cable between ped head and APS unit, then disconnect the (3) jumpers that go between the ped head terminals to the circuit board, remove circuit board out of ped head and remove the APS unit off the pole. Remove the pushbutton sticker off the pole. Plug holes left from removal of APS unit, it shall be filled with an appropriate epoxy filler to cover the hole leaving a smooth finish, and or if the hole is of a size that a box plug can be installed this application requires a ½" or ¾" NPT tap, this is the preferred way to fill the hole.

Install -- consists of attaching circuit board in ped head using an industrial strength Velcro to securely attach to back side of ped head so it stays attached, install a small (3) conductor jumper with orange, blue and white colored wire between the circuit board and the ped terminals on the ped head to the appropriate terminals, then install the small cable (that comes with APS unit) from circuit board to the APS unit, attach the APS unit on the pole that will allow the arrow pushbutton indicator on the APS unit to be centered at 42" up from ground level, make appropriate wiring connections including the pushbutton wire to the APS unit and test all aspects of operation of an APS unit. Then install new ped pushbutton sticker on pole above APS unit.

Removal and replacement -- APS unit and or Circuit board consists of a removal of either of the units and then install a replacement and hook up wiring appropriately and test all aspects of operation of an APS unit.

Audible Ped Removal (Coo-Coo – Chirp) (95)

Disconnect and remove old unit off top of ped head, then plug the hole with the use of large washers/nut bolted together then use clear silicone caulking to seal it off so no moisture will leak into ped head.

Signs and Mounting Brackets

(96 thru 101)

General Note on Sign Installs -- Placement and position will be given by Senior Signal Tech/II and/or shown on project plans. Signs shall be slightly angled down so visibility to driver is optimal and reflection is minimized. Signs shall be uniform and level to fit in with the other signal equipment on pole/arm. If multiple signs are mounted side by side there shall be 2-3 inch gap in-between them. For signs mounted on mast arms that use the formed posts then Astro bracket are necessary to be used for this application.

Install -- Consists of install of mounting bracket on signal pole/mast arm, and then attach sign in mounting bracket.

Remove – Consists of removal of sign and mounting bracket.

Move and adjust -- Consists of removing the mounting bracket and sign and re-installing it at a different position on pole or arm. A new mounting bracket and or sign may be given to the contractor for this purpose if deemed necessary.

Special FYA Signs -- When mounting this specialty sign the signs arrow shall be in line with and beside the Flashing Yellow Arrow in the signal head.

Blank Out Sign Install or Removal (102,103,104)

Install -- consists of drilling hole in pole or arm installing mounting bracket, attaching blank out sign and making all wiring connections. Test and verify proper operation.

Removal – Consists of removal of the blank out sign, mounting hardware and removal of the wire/cable to its termination point in pull box and disconnected at the cabinet.

Removal and Replacement – disconnect blank out sign, remove the faulty or damaged sign and then install a new sign and reconnect wiring. Test and verify proper operation.

Radar/Variable Speed – Driver Feedback Signs (DFS)

(105,106)

General Note on Sign Installs -- Signs shall be aimed and leveled as per manufacture guidelines, adjustments may be necessary in the bracket using shims to achieve the proper angle of the sign for optimal operation/detection and visibility; this shall be inclusive of the installation of the sign. Signs shall be fully functional and tested to be a complete installation. Contractor shall contact the Senior Signal Technician/II when finished with sign and test so they can verify it is operating as expected.

Install – Consists of drilling, mounting hardware, sign install and connecting appropriate wiring in sign. Contractor shall supply bandit, seal tight connector for entrance to pole.

Removal – Consists of disconnecting wiring, removal of sign and mounting hardware. Removal of wiring and or cable back to termination point is inclusive of removal. Plug holes left from removal of APS unit, it shall be filled with an appropriate epoxy filler to cover the hole leaving a

smooth finish, and or if the hole is of a size that a box plug can be installed this application requires a ½” or ¾” NPT tap, this is the preferred way to fill the hole.

Removal and Replacement -- Consists of disconnection of wiring in sign, removal of faulty sign and mounting bracket if needed, then install of new sign and mounting brackets if necessary, reconnect the wiring inside the sign.

Video, Radar, PTZ or Infrared Detector, Install/Aim &/or Removal/Replacement (107 thru 110)

General Note for Installs or Replacements – Contractor shall get the location for install of the camera from the Senior Signal Tech/II prior to installation. Once the camera is powered up the Signal Technicians shall work with contractor to get proper aim, angle and adjustment of camera. Confirm and verify the camera is working properly.

Install – Consists of drilling hole in appropriate position given by Senior Signal Tech/II, install mounting hardware and camera making all wiring connections. Components that are necessary to make camera/s operational in cabinet shall be installed by contractor in the cabinet with all cabling and wiring connected.

Removal – Consists of disconnecting camera, removing camera and mounting bracket, remove wiring/cable back to termination point. Details of wire removal shall be given by Senior Signal Tech/II as to how far it is to be removed. NOTE – If removing a Solo Pro Econolite camera it will be a different removal task for cable removal (Do Not cut any Connectors Off) and get detail direction from Signal Technicians.

Removal and Replacement – Consists of disconnection of wiring in camera, removal of camera, then install a new replacement camera in mounting bracket and reconnect wiring to camera.

Cable / Conductors and Wiring (111 thru 125)

General

Cable and conductors shall conform to the applicable I.M.S.A. 19-1 specifications. The individual conductors in multi-conductor cable shall be 14 gauge stranded, tinned copper wire rated at 600 volts and individually insulated in heat stabilized polyethylene or unless otherwise stated below.

Termination Materials and all Connections

All materials used to make connections or splices for wiring as in: Buchannan’s/rubber caps, spades, 3-M connectors, wire nuts and electricians tape, color tape, tags, wire ties etc. shall be furnished by the contractor and incidental to the work being performed. Connections of wire/cables to any component/equipment/cabinet are considered a part of F/I of wire or cable.

Wiring Installation

All electrical work shall meet applicable codes and regulations.

Sufficient signal light conductors shall be provided to perform the functional operation of the signal system. Additional conductors for service, interconnect, etc. shall be provided as noted on the plans.

Separate conduits for low voltage (24 volts or less) and high voltage conductors (more than 24 volts) shall be provided in all signal installations.

All conductors shall be installed in conduit unless installed in poles, pedestals or mast arms.

Unused conductors in each cable shall be folded back on the cable and neatly secured with Black Electricians tape.

Splices of conductors shall be connected with Buchanan style connection with a rubber diaper over each connection and shall not be soldered or taped. 2006 Buchanan is used for three (3) conductors and less and 2011 Buchanan is used for four (4) conductors or more. There shall be no crimping of the Buchanan with a normal crimp tool only use of the specified Buchanan tool. On all cable/wiring when stripping off the individual colored sheathing and where the Buchanan is placed there shall be approximately ¼" of bare wire left below the Buchanan. Cables from signal heads and pedestrian heads on the mast arm/pole shall be spliced in pull box on corner by pole location, unless approved by Senior Traffic Signal Technician/II. The exception is the Solo Pro video cameras and street lights which shall be spliced in pole bases. Pushbutton, FLIR cameras, loop, and Opticom wiring lead-in cables shall not be spliced but go straight from their origination point to the cabinet. Wiring shall follow the conductor schedule in the plans.

A bare # 8 AWG copper conductor shall run continuously in one of the conduits in each leg of the intersection for traffic signal circuits. This bare wire is used for bonding and grounding purposes. NOTE – Conduits going between signal cabinet and main pull box will not contain any ground wire.

21c/25c multi-conductor cables entering cabinet shall be left 8' long and stripped of outer sheathing back 3' from end of cable. After taping back unused conductors on cable then 21c/25c cable shall be laid neatly under top of cabinet base with only used conductors coming up to connect to terminals.

7c/5c, multi-conductor cables entering cabinet shall be left 8' long and striped of outer sheathing back 3' from end of cable. After taping back unused conductors on cable then they shall be laid neatly under top of cabinet base with only used conductors coming up to connect to terminals.

Advance loop, video, Opticom and pushbutton cables etc. entering cabinet shall be left 11' long and stripped back approximately 5' from end of cable. After taping back unused conductors on

cable then they shall be laid neatly under top of cabinet base with only used conductors coming up to connect to terminals.

The standard shall be as a minimum:

(New Installations or Complete Re-Wire) One 21c/25c multi-conductor cable to each corner pull box from the cabinet with no splices between these two points. The size that will be called for will be determined on a project bases as per Senior Signal Tech/II.

One (3) pr. (individually shielded pair) multi-conductor lead-in cable to each stop bar loop pull box shall run from the loop pull box straight into the cabinet. In the cabinet the multi-conductor shall have the sheathing and aluminum stripped back approx. 4-5 “

One (3) pr. (individually shielded pair) multi-conductor lead-in cable to each advance loop pull box shall run from the loop pull box straight into the cabinet. There may be cases where additional lead in cable is required due to additional lanes etc. If and when this exists the plan for cables will be determined in the field as necessary by the traffic signal technician.

One (3) pr. multi-conductor # 16 to each signal pole and or ped pole with (2) pushbuttons on it.

One (2) pr. Multi-conductor # 16 to each pole for pushbutton with no splices between the button and the cabinet. For use in the case of either a ped pole and a signal pole or (2) ped poles with a pushbutton on each one.

One 5c multi-conductor cable from each (3) section head to the pull box by the pole.

One 7c multi-conductor cable shall be pulled to each signal head on the end of the mast arm, so it is capable of running a 3, 4 or 5 section head. In addition, when called for a SOP head with the left and right turn arrows, and or any other specialized signal head as specified in plans/drawings.

One 5c multi-conductor cable from each pedestrian head to the pull box by the pole.

FLIR (IP) cameras shall have the CAT 6 Ethernet cable and (3) SJOW conductor power cable installed from cabinet to camera.

FLIR standard camera shall have the 5c w/coax cable installed from cabinet to camera.

Solo Pro video camera shall have the specialized cable/connector supplied by the City installed from the camera to the hand hole in the pole base, and spliced into a cable of which is (6) pair (twisted numbered pairs) 18 gauge wire with one bare ground wire and shielded on outer core, this cable will be non-stop/splice continuous run to the cabinet.

One Opticom cable of 3-M model 138 from each Opticom head straight to cabinet no splices in between.

12/2 insulated # 14 wire will be used for each street light and around the intersection, street lights shall be terminated in the pole bases with 2' of slack extending from out of hand hole.

Connections to signal heads, pushbuttons and cabinets shall be secured to the screw type terminals in the traffic signal heads, pedestrian pushbuttons and cabinet. The connectors shall be of the spade tongue type and shall be affixed to the conductors using a tool designed specifically for the connection of the connectors to the conductors.

When wiring pushbuttons in poles the cables going to the pushbuttons shall have the outer sheathing and the aluminum protective shield stripped back from connection on pushbutton to below hand hole in pole base, this is to enable identification of which pair goes to which button up in pole. Extra pair is to be rolled up neatly and taped back.

4' of slack shall be left for each conductor/cable at each signal/pedestal pole and three feet of slack at each pull box containing cable connections/splices.

When doing any wiring, splicing in pull boxes contractor shall do the work in such a manner as to keep wiring/splices separate, neat and not tangled and intertwined. Cables and splices shall be done in a manner that when necessary to trouble shoot the wiring a technician can easily pick up and separated the groups of cables so splices can be checked and evaluated easily for problems.

For all cables that are looped through a pull box there shall be 4' to 5' of slack so that it lies down nicely in bottom of pull box. Sheath for detectors shall not be grounded.

The wiring for each mast arm mounted signal head shall be marked with colored Electrical tape (as per table listed below) in each pull box down from splices approximately 4-5 inches. Looking at front of mast arm the heads, starting from left to right, the first (3) section head on the arm will be # 1 head using one directional color tape, then the next (3) section head on arm shall be # 2 with two directional color tapes, and if there are (3) heads then the third head will be # 3 with three directional tapes on it. Side of Pole heads shall be marked with 3, 4, or 5 directional color tape bands; it all depends on the number of heads on the mast arm. If there is a left turn (5) section head it shall be marked with two bands of directional colored tape with one added band of white tape. If it is a (3) section protected left turn head or a (4) section with the flashing yellow arrow then it shall have the normal number of directional colored tape bands # 1, to tell which head it is in the lineup and also one added band of white tape.

Ped heads shall be marked with a yellow to designate Ped movement cable and then the appropriate color tape for the direction/phase.

For the newer right turn/overlapping arrows the pair of wires shall be marked with a brown tape along with one directional color tape.

Connections in the Signal Cabinet

All wiring shall be arranged in an organized separated manner as it is connected to the terminals and equipment, no crisscrossing and no tangled intertwined wiring as it goes to the terminals from the cables. All cables shall have color-coded tape to distinguish what direction/corner the cable is operating. The conductors coming out of each cable shall also have color code tape around each group of conductors distinguishing the proper function, this tape shall be put on the conductors approximately 3-4 inches above the stripped off sheathing using 4-5 wraps of color coded tape. There shall be tags 3 inches below connection of wire to terminal on the groups of conductors with written wording describing the phase and direction. The tags shall be attached using zip ties and permanent marker for the writing. Cable lengths and wiring lengths with details on each are indicated above by type of conductor.

Regarding neutral wiring connections ---- High voltage neutrals are to be connected to the neutral buss on the lower left side of cabinet and they shall be connected separately with one wire per lug being used. The pushbutton grounds are to be connected to the ground buss on the right lower side of cabinet.

Color Code Marking with Tape

All wiring in pull boxes and in cabinet shall be color coded with the proper color code tape indicating the directions/phasing/function i.e.: signal wiring, opticom, cameras, and loops.

City of Longmont Color Code Key

North	-----	Red
East	-----	Orange
South	-----	Green
West	-----	Blue
Left Turn	-----	White
Ped head / pushbutton	-----	Yellow
Right Turn	-----	Brown

Wiring code below is for our 19c, 21c or 25c cables

CONDUCTOR COLOR INDICATION TAPE COLOR

Northbound Through Vehicles:

Green (solid) Green Ball Red

Orange (solid) Yellow Ball Red
Red (solid) Red Ball Red
White (solid) Neutral

Protected/Permissive Northbound Left Turns (Overhead):

Blue (solid) Green Arrow Red + White
Black (solid) Yellow Arrow Red + White
White w/black tracer Neutral

Southbound Through Vehicles:

Green (solid) Green Ball Green
Orange (solid) Yellow Ball Green
Red (solid) Red Ball Green
White (solid) Neutral

Protected/Permissive Southbound Left Turns (Overhead):

Blue (solid) Green Arrow Green + White
Black (solid) Yellow Arrow Green + White
White w/black tracer Neutral

Northbound and Southbound Pedestrians:

Green w/white tracer Walk Green or Red + Yellow
Red w/white tracer Don't Walk Green or Red + Yellow

White w/red tracer Neutral

Eastbound Through Vehicles:

Green w/black tracer Green Ball Orange

Orange w/black tracer Yellow Ball Orange

Red w/black tracer Red Ball Orange

White (solid) Neutral

Protected/Permissive Eastbound Left Turns (Overhead):

Blue (solid) Green Arrow Orange + White

Black (solid) Yellow Arrow Orange + White

White w/black tracer Neutral

CONDUCTOR COLOR INDICATION TAPE COLOR

Westbound Through Vehicles:

Green w/black tracer Green Ball Blue

Orange w/black tracer Yellow Ball Blue

Red w/black tracer Red Ball Blue

White (solid) Neutral

Protected/Permissive Westbound Left Turns (Overhead):

Blue (solid) Green Arrow Blue + White

Black (solid) Yellow Arrow Blue + White

White w/black tracer Neutral

Eastbound and Westbound Pedestrians:

Orange w/red tracer Walk Orange or Blue + Yellow

Black w/red tracer Don't Walk Orange or Blue + Yellow

White w/red tracer Neutral

Protected Left Turn for Northbound, Southbound, Eastbound and Westbound (overhead):

Blue (solid) Green Arrow Red or Green + White

Black (solid) Yellow Arrow Red or Green + White

Blue w/red tracer Red Arrow Red or Green + White

White w/black tracer Neutral

Southbound or Northbound Protected Left Turn (3 section) mounted on SOP on EB & WB poles:

Red (solid) Red Arrow Red or Green + White

Orange (solid) Yellow Arrow Red or Green + White

Green (solid) Green Arrow Red or Green + White

White w/black tracer Neutral

Eastbound or Westbound Protected Left Turn (3 section) mounted on SOP on NB & SB poles:

Red w/black tracer Red Arrow Orange or Blue + White

Orange w/black tracer Yellow Arrow Orange or Blue + White
 Green w/black tracer Green Arrow Orange or Blue + White
 White w/black tracer Neutral

Westbound or Eastbound Prot/Perm Left Turn (5 section) mounted on SOP, NB & SB poles:

Red w/black tracer Red Ball Blue or Orange
 Orange w/black tracer Yellow Ball Blue or Orange
 Green w/black tracer Green Ball Blue or Orange
 White (solid) Thru movement neutral
 Black w/white tracer Yellow LT Arrow Blue or Orange + White
 Blue w/white tracer Green LT Arrow Blue or Orange + White
 White w/black tracer LT neutral

CONDUCTOR COLOR INDICATION TAPE COLOR

Southbound or Northbound Prot/Perm Left Turn (5 section) mounted on SOP, EB & WB poles:

Red (solid) Red Ball Green or Red
 Orange (solid) Yellow Ball Green or Red
 Green (solid) Green Ball Green or Red
 White (solid) Thru movement neutral
 Black w/white tracer Yellow LT Arrow Green or Red + White
 Blue w/white tracer Green LT Arrow Green or Red + White
 White w/black tracer LT neutral

Flashing Yellow Arrows for NB, SB, EB, WB (4 – section) Overhead:

Blue w/red tracer	Red Arrow	Color code per direction
Black (solid)	Yellow Arrow	“ “
Blue w/black tracer	Flashing Yellow Arrow	“ “
Blue (solid)	Green Arrow	“ “
White w/black tracer	Neutral	

Flashing Yellow Arrows for SB & NB (4 – section) on SOP's on EB & WB poles:

Red (solid)	Red Arrow	Color code per direction
Orange (solid)	Yellow Arrow	“ “
Black w/white tracer	Flashing Yellow Arrow	“ “
Green (solid)	Green Arrow	“ “
White w/black tracer	Neutral	

Flashing Yellow Arrows for WB & EB (4 – section) on SOP's on NB & SB poles:

Red w/black tracer	Red Arrow	Color code per direction
Orange w/black tracer	Yellow Arrow	“ “
Black w/white tracer	Flashing Yellow Arrow	“ “
Green w/black tracer	Green Arrow	“ “
White w/black tracer	Neutral	

Note -- Solid White is neutral for all thru's, white w/black tracer is neutral for all left or right turns, and

White w/red tracer is neutral for all pedestrian signals.

SB / NB / EB / WB (5 – section head) Right SOP thru w/right turn arrow overlap:

When this application is used it will need to be determined in the field as to what will be used for wiring in the 19c or 21c and is dependent on what is available at that particular intersection. In some cases it may be required that an extra cable will be pulled in to accommodate this additional movement. Traffic Signal Division will evaluate as needed.

Wiring for overhead or SOP heads to pull box

7c and 5 c to signal heads (Thru Movement or Protected Left Turn Movement)

Red wire is used for either Red ball or Red Arrow

Orange wire is used for either Yellow ball or Yellow Arrow

Green wire is used for either Green ball or Green Arrow

Solid White is used for the neutral

7c for a Protected/Permissive (5)sec. Left Turn head and or Right Turn Overlap head

Black wire is used for Yellow Arrow

Blue wire is used for Green Arrow

White w/black tracer is used for the neutral in (2 sec. portion of head)

5c for Pedestrian heads (For all Directions)

Red wire is used for all Don't Walks

Green wire is used for all Walks

Solid White is used for the neutral

7c for FYA heads (For all Directions)

Red wire is used for Red Arrow

Orange wire is used for Yellow Arrow

Green wire is used for Green Arrow

Black wire is used for the Flashing Yellow Arrow

Solid White is used for the neutral

* * A white conductor jumper shall be installed from between the (2) neutral terminal blocks in head sections to connect it as one neutral; we do not want two neutrals feeding this one head.

Pushbutton Wiring Connections

For North and South bound phases the Black and White pair shall be used

For East and West bound phases the Red and Black pair shall be used

Spare pair shall be the Green and Black (rolled up and taped back at hand hole)

Loop Wiring Connections

Please contact Senior Signal Tech/II for direction on connections, it will vary by project.

Service Systems

General

Two separate eight gauge copper tinned stranded wires individually insulated in heat stabilized polyethylene shall be used for service connections, one white for neutral AC - and one black for the hot

AC +. It shall run from the controller cabinet to the point of service connection being either pull box or service pole pull box, leaving three extra feet of wire in the pull box. If service cables are looped through pull boxes on way to cabinet then there shall be approximately 3' of slack wire in each pull box so that it will lie down nicely in bottom of box.

When installing the service for the traffic signal there shall be an additional feed for the street light service, this shall be determined by Longmont Power and Communications.

Service points shown on the plans are approximate only. The exact location will be determined in the field by City of Longmont Power and Communications (LPC) and Senior Traffic Signal Technician/II or shown on plans. The electrical service connections will be made by the City of Longmont Power and Communications Department (LPC) or Contractor- this will be a field decision determined by project details. The contractor shall be responsible for coordinating the service connection with LPC if it is for a large Project under a Prime contractor.

Conduit

General

Conductors shall be run in conduit except when run in metal poles. Conduit shall be of the rigid PVC type.

Electrical conduits running to the control cabinet shall enter from the bottom of the cabinet base unless otherwise noted on the plans. Conduit runs shown on the plans are schematic. Final

routing may be changed as directed by the Senior Traffic Signal Technician/II to avoid underground obstructions. In the event of any change from the location shown on the plans, accurate records shall be kept for as-built drawings and necessary details submitted to the Senior Traffic Signal Technician before final payment is made.

PVC Conduit

PVC conduit shall be Schedule 40, type 2, as specified in the NEC and shall be manufactured of high-impact PVC, shall conform to industry standards and commercial standards No. CS-207-60. Each length of PVC conduit and various PVC fittings (expansion joints, couplings, adapter, etc.) shall bear the label of Underwriter's Laboratories, Inc. The conduit shall be of the size or sizes shown on the plans. Rigid PVC conduit shall be cut and all ends shall be trimmed after cutting and filed down to remove rough edges. All connections shall be of solvent weld type.

Conduit that is being installed by way of pulling and or pushing shall be H.D.P.E. schedule 40 or approved equal.

Solvent weld joints shall be made in accordance with the PVC manufacturer's recommendations. Rigid PVC conduit shall only be used for underground installations; all conduit used above ground shall be of the rigid galvanized steel type.

Nylon pull tape (not string) with a 1500 lb. test of not less than 1000 lb. tensile strength shall run continuously in all circuits.

Conduit Installation

Conduit sizes and locations shall be as shown on the plans, although for all new and/ or rebuild installations the City's minimum shall have: a crossing on (3) legs with each leg running (2) --- 3" PVC, (2) --- 2" PVC. For work on signal upgrades or small projects the conduit sizes will be specified on plans or by the Senior Traffic Signal Technician/II or project plans. Conduit installation for future use shall terminate in a pull box and each conduit end shall be capped with standard conduit caps.

On any runs of conduit there shall only be a maximum of 270 degrees of conduit: meaning only up to (3) 90 degree elbows shall be allowed going from point to point. If for some reason they need to go beyond the 270 degrees then the contractor shall contact the Senior Traffic Signal Tech/II and they can give approval so it will be noted or documented on drawings. On existing facilities if contractor is working and this cannot be achieved then again contact Traffic Signal Operations to get assistance in alternative options.

Conduit running from pull box to pole base shall consist of (2) --- 3" PVC's. The minimum conduit going into cabinet base shall consist of (2) --- 3" PVC, and (2) --- 2" PVC.

Existing underground conduit to be incorporated into a new system shall be cleaned with a cylindrical wire brush and or blown out with compressed air there by leaving it open and unobstructed.

Conduits terminating in cabinet bases shall extend to a height of 6" below top of cabinet base. Conduit terminating in pole bases shall extend a maximum of (1) foot and a minimum of (8) inches above the caisson vertically, and shall be sloped toward hand holes in poles or base opening where transformer bases are used. Conduit entering pull boxes shall terminate a minimum of (4) inches and a maximum of (6) inches above the bottom of the box.

All conduit ends shall be accomplished by 90 degree long radius elbows. Where two or more conduits meet, all 90 degree long radius elbows shall be brought together in the center of the pull box or cabinet base. Conduit shall only enter through the bottom of a pull box. Conduit shall be laid to a depth of not less than

30" inches below the curb grade of roadway construction and or below finished grade ground level. Conduit under railroad tracks shall not be less than 42 inches below the bottom of the tie or as specified by railroad code. It shall be the responsibility of the Contractor to obtain clearance from the railroad before any work is done within the railroad right-of-way. The minimum size of conduit to be used will be shown on the plans.

If the contractor runs into underground items such as: small/medium pieces of concrete, wood, asphalt, and or rocks it shall be considered part of the conduit installation to remove it as they install the conduit. If it is something that requires specialized or additional equipment be brought in then it will be brought to the attention of Senior Signal Tech/II for approval of extra charges, if project is being done under City Traffic Signal Contract.

Underground conduit will be placed either by trenching or boring. The decision to trench or bore will be made on a case by case basis by the Senior Traffic Signal Technician/II project plans. Trenching and boring will be done in accordance with the applicable sections of the City of Longmont Design Standards and Construction Specifications.

All conduits installed shall be left clean and free of any debris.

Contractor shall call for inspection by COL Senior Traffic Signal Tech/II when conduit is installed by trenching, and or attaching to bored conduit and in general when conduit is installed into pull boxes or cabinet bases to confirm proper connections and installation.

Depths of Conduits Installed

When conduit is installed the COL depth requirements shall be minimum of 30" and maximum of 5' below surface grade. If this cannot not be achieved for any reasons then the contractor shall contact COL Signal Operations prior to installation to discuss and get approval in writing to allow the deviation. If contractor does not get prior approval from COL to deviate from the requirements then the conduit may be required to be re-installed at the required depths at their expense.

Install Conduit by Trenching

(127 thru 134)

Conduit installation includes, 90 degree long radius elbows into pull boxes, nylon pull tape with a 1500 lb. test, adaptors and conduit. Conduit will be measured by the linear foot in place and shall include all saw cutting, excavation, backfill, removal of pavement, sidewalks, gutters, curbs and landscaping and their replacement in kind to match existing conditions.

Dirt -- Trenches will be backfilled and compacted to a minimum of 90% compaction and restored to existing conditions.

Sod/Landscape -- Trenches in sod will be backfilled to a minimum of 90% compaction and sod and or landscaping replaced to match existing conditions.

Asphalt -- Trenches in asphalt shall be filled with flow fill around conduit then hot asphalt shall be laid in the trench to match existing roadway as per City Design and Construction Specifications.

Concrete

Installation of conduit in concrete will require the removal of the concrete by saw cut cleanly on both sides so as to leave surrounding concrete intact free of chipped or cracked edges, with the minimal trench size of 1' for multiple conduits and if the installation is only for one single conduit the size of the trench removal will be no more than 6" wide. The trench shall be either with flow fill (at no extra charge) and or backfilled and compacted to a minimum of 90% compaction, pins will be supplied and installed in existing concrete centered in the existing concrete with 18" between pins then a minimum of 4" of concrete on top and finished leaving an even smooth surface for pedestrians to move safely across.

All work shall be done as shown on plans or directed by the Senior Traffic Signal Technician/II or project Engineer.

When a trench is opened and conduit installed, whether it is asphalt or concrete it shall be filled back in same day. If for valid reasons it has to be put off a day or two then steel plates shall be installed over trench and secured properly so that traffic can safely pass over the trench until the permanent replacement is completed.

Install Conduit by Boring

(135 thru 144,241)

Conduit installation includes 90 degree long radius elbows into pull boxes, nylon pull tape with a 1500 lb. test, adaptors and conduit. Conduit will be measured by the linear foot in place. E-LOC couplers shall be used to attach PVC to the poly pipe used in bore runs. Shall include any saw cutting, excavation for push or bore pits or incidental excavation, backfill, jacking, drilling pits, removal of pavement/sidewalks/gutters/curbs/potholes and all replaced to match the

surrounding existing conditions. Any landscaping area disturbed shall be compacted to a minimum of 90% and replaced to match original conditions.

In many cases it will be necessary to prepare a bore pit to receive a bored in conduit/s to keep it as close to the location it is intended to be brought up in, this will be required so that the length of the bore does not have to be longer to come up where it is easier to find but more expensive on costs.

All work shall be done as shown on plans or directed by the Senior Traffic Signal Technician/II or project Engineer.

Plan and profile drawings are required prior to installing any conduit by bore. All utility crossings shall be potholed and visually verified prior to installing conduit.

Pull Boxes

General

Pull Box locations shown on plans are approximate it may be necessary to adjust locations due to utilities and right of way issues. If not on a drawing then Senior Traffic Signal Tech/II will give location for installation. On long conduit runs, pull boxes shall not be spaced more than 300' apart. Pull boxes installed at less than 300' spacing to facilitate work may be installed by the Contractor at their expense and with the approval of Senior Traffic Tech/II.

Pull boxes must have lids with the words "Traffic Signals" printed on them. Pull boxes and lids shall hold a minimum vertical test load of 20,000 lbs. over a 10" X 10" surface with no physical damage or excess deflection. For the (Extra Large) Pull box 24" x 36" x 18" the lids shall be the split lid type.

Pull boxes used for loop detector connections shall be (small size) 11" x 18" x 18".

Pull boxes used at all junctions of roadway conduit crossing shall be a (medium size) 13" x 24" x 18". With the exception of the main pull box by the controller cabinet and it shall be a (large size) 17" x 30" x 18" and or (Extra Large) w/split lid 24"x36"x18".

Type/brand and size of pull boxes will be off of the City of Longmont Traffic Signal approved materials list.

Use of two pull boxes in place of a larger one side by side shall not be permitted. On any signal upgrade, re-build or modification project it shall not be permitted to install an extra pull box on a corner by a pole with an existing pull box in order to avoid extra costs of up sizing a pull box or extra work to properly get conduit into existing pull box. Any addition of pull boxes to a project shall be approved by Senior Traffic Signal Technician/II.

If approved by Senior Traffic Signal Tech/II in certain circumstances it shall be allowed to stack a pull box on top of another one to achieve the correct grade set for the pull box.

If a pull box is not installed properly at correct grade level, then it will be the contractors' responsibility to adjust all components to achieve proper set of the pull box at grade level at no extra charge. This may include having to add rock, extend conduits and reset box.

Conduits in pull boxes shall be terminate a minimum of (4) inches and a maximum of (6) inches above the bottom of the box.

Pull Box Removal, All Sizes

(145 thru 148)

Removal of a pull box from dirt, sod or landscaping shall be done with minimally disturbing the surrounding area. If a pull box is being removed permanently then contractor can remove the pull box using their discretion of how to best remove it. Contractor shall restore surrounding area around pull box to match existing area. Removal of pull boxes in asphalt or concrete for purposes of replacement will require the contractor to saw cut 6" larger than the replacement pull box they will be installing. This means they will need to have the exact size of pull box being installed to come up with these measurements to meet this standard and this information will be provided by the Senior Signal Technician/II.

Pull Box Installation, All Sizes

(150 thru 181)

On all pull box installations there shall be 6" – 8" of ¾ " crushed rock under each pull box and 3/4" crushed rock filled inside the pull box 2" below the top of the conduits for proper drainage. On all pull boxes installed in dirt, grass and or landscaped area the grade of the pull

box shall be 2" above the final grade. It is the responsibility of the contractor to find out what the final grade is going to be if it is in a construction area. Contractor shall restore surrounding area around pull box to match existing area.

There shall be no expansion material used around the outside top perimeter of pull box. Installed pull boxes shall be level with the finished grade of the concrete area, this shall be critical to prevent tripping hazards and or water collection issues.

Pull boxes not installed in concrete shall have concrete rings poured around them (refer to concrete ring specifications below).

Concrete Ring Install on Pull boxes

(182 thru 185)

Pull boxes not installed in concrete shall have a concrete ring poured around them 10" wide and 9" deep to prevent the pull box from settling below finished grade and allow efficient maintenance. When pull boxes are in dirt or grass areas the concrete rings shall be 2" above grade so that dirt and grass will not easily grow over the top and become hidden. The top two inches of the concrete shall be formed with rounded edges as to leave it square with a professional finished look to it.

The concrete rings shall not be poured unless temperatures are above 32 degrees at nights for (4) consecutive days/nights after pour of rings. If there is a situation where it is necessary that the concrete rings need to be poured at a time of year when temperatures are under 35 degrees then they will need to add a calcium chloride chemical to concrete following the proper directions to ensure the concrete will not freeze and will set up properly. It shall be the contractor's responsibility to protect the concrete until it is dry to ensure it will be finished properly and professionally.

Concrete Ring Removal

(149)

Concrete shall be broken up and removed as necessary, contractor shall dispose the concrete. If a new ring is not being installed then contractor shall fill in around pull box and restore to match existing surroundings.

Round Loop Valve Pull Boxes, Install &/or Remove

(186 thru 195)

Round Loop Valve type pull boxes shall be used for loop detector wire.

Round Loop Valve pull boxes shall be a water valve stem type pull box made of cast-iron or steel off of the approved materials list. The pull box shall have the capability of accepting riser rings for future roadway overlays. The lid shall have the word "traffic" printed on it.

Round Loop Valve shall be located as shown on plans but may be adjusted if necessary by Senior Traffic Signal Technician/II.

(2) feet minimum slack of both feed and loop wire is to be provided so that all testing and splicing can be done outside of the pull box.

Removal

Round Loop Valves being removed from existing concrete roadways shall have the diamond cut out (2' x 2') installed surrounding the valve box, if there is no replacement loop valve being installed then the concrete used to fill in the void shall meet the City of Longmont Design Standards and Construction Specifications.

If a loop valve is being removed in asphalt and no replacement is going in then it will only require removing enough asphalt to get the valve out and then replacing the asphalt with hot mix type asphalt, (cold mix will not be acceptable) to a proper compaction.

Installation

Round loop valve pull boxes shall have 18" – 2' of $\frac{3}{4}$ " crushed rock under valve box with (2) concrete bricks type ASTM C55 under the valve box to keep it from sinking. When loop valve is at final grade it shall be $\frac{1}{4}$ " below final grade of either concrete or asphalt this is to ensure plows will not catch and break the valves. When installing a new or replacement loop valve the

contractor shall drill a 1 1/8th" hole and install a 4-6 inch piece of tube (1" diameter) approximately 6" – 8" down from top of loop valve, this is to protect the loop wire from getting cut/scraped.

Round Loop Valves installed in existing concrete roadways shall have the diamond cut out (2' x 2') installed surrounding the valve box, each side of the diamond cut out shall have two steel 8" in length by 1/2" diameter dowels (rebar) that will go from the old concrete to the new. The concrete used shall meet the City of Longmont Design Standards and Construction Specifications.

When installing the valve box in existing asphalt contractor shall saw cut out a (2' x 2') square then install the loop valve with the specification mentioned above, the void shall be cleaned of all debris and tack applied before the asphalt is installed, then the asphalt shall be compacted properly. The asphalt shall be the hot mix type asphalt (cold mix will not be acceptable).

If loop valve riser ring is used to bring valve to proper grade then it shall be installed in a manner to which the riser will not detach from the main body of the valve as traffic drives over it. The overall grade of the loop valve including the riser shall be 1/4" below the final grade of either the concrete or asphalt. The contractor shall determine an acceptable way to do this and have it approved by the Senior Traffic Signal Technician/II.

Note – If installing a round loop valve in a new roadway then it shall only be necessary to set and stabilize valve so that when the concrete or asphalt contractor applies the new roadway they do not damage the valve or conduit and it remains in place as it should. With this installation there is no asphalt/concrete needing to be supplied by Contractor.

Concrete Removal or Installation

(196,197)

Removal -- Prior to any removal and disposal of concrete the contractor shall evaluate the condition of the concrete and note areas that are already cracked or damaged so that they will not be held responsible for any damage in an area they are not working on. For precise removal of concrete from within an area where there will still be existing concrete it will be required that the contractor saw cut out the area of concrete to be removed, being careful not to chip or crack the concrete that will be staying in place to ensure the seams are nice and smooth, if contractor does chip/crack this concrete they shall then remove a larger portion at contractor's expense. Contractor shall not over cut corners leaving cuts beyond the area removed.

Contractor shall remove and dispose of the broken up concrete and restore the area to existing surroundings.

Installation -- F/I of concrete and Installation shall be as per the City's current design standards and construction specifications. It also includes cleanup of area and restoring the adjacent landscaping back to match existing conditions. Leaving a professional finish.

F/I Flow Fill

(198)

This item includes placing controlled low-strength material to fill voids. Controlled low-strength material shall be a cementitious fill that is self-consolidating and has the ability to fill voids.

The mix design shall generally conform to the following requirements:

A. Cementitious Materials:

- 1) Cement: Type II Portland cement in accordance with ASTM C 150.
- 2) Fly Ash: Class C or Class F in accordance with ASTM C 618.

B. Aggregates:

- 1) Fine Aggregate: In accordance with the grading and quality requirements of AASHTO M 6.
- 2) Coarse Aggregate: In accordance with the grading and quality requirements of AASHTO M 80 for Sizes No. 467, No. 57, or No. 67.

C. Water: In accordance with the requirements of ASTM C 94.

D. Admixtures: Admixtures that do not contain calcium chloride and are in accordance with ASTM C 494 for concrete may be used. Admixtures shall be compatible with the cement and other admixtures.

E. Proportions:

- 1) Total cementitious material: 50 to 95 lb/cy.
- 2) Fly ash by weight: Maximum 40% of total cementitious materials.
- 3) Slump (ASTM C 143) - Min: 6 inches; Max. 8 inches.
- 4) Fine aggregates: Between 50% and 60% by volume of total aggregate.
- 5) Compressive strength at 28 days: 50 to 150 psi when molded and cured in accordance with ASTM D 4832.

Potholing for Utilities

(199 thru 202)

The contractor shall pothole for utilities for any excavation or bore to protect all utilities. Potholes will be required on all bores crossing natural gas, fiber optic lines, cable TV, electric and water lines as well as sanitary and storm sewers.

The number of potholes to be determined by contractor. Potholes shall be restored with structural class 6 road base compacted and topped off with Quickset 45 filler; otherwise if larger void is encountered then flow fill will be required.

Luminaire Arm/Street Light Head

(203,204)

Removal -- remove the arm/head and return it undamaged to the City Traffic Signal Shop or other designated area directed by the Senior Traffic Signal Technician/II if it is a permanent removal then the wiring will be removed and disposed of as part of the removal.

Installation -- install the arm/head on signal pole; connect wiring to head leaving it operational. A (20) amp fuse with a fuse holder shall be installed at hand hole. Senior Traffic Signal Tech/II will give contractor the angle/degrees for which the street light arm shall be installed on signal pole.

F/I Loops

(205 thru 208)

Installation of loops shall include saw cut, clean out, proper loop wire, hot rubberized asphalt sealant, connectors and testing, leaving the loop operational and as shown on plans or as directed by the Senior Traffic Signal Technician/II or designated field representative. Sizes most generally used will be either a 6' X 30' quadrupole or a 6' X 6' hexagonal.

If we request bicycle loops, either in bicycle lanes on street or on paths near intersections. Contact Senior Traffic Signal Tech/II in Traffic Operations 303-651-8699 for detailed loop specification.

Installation of SDLC Hub and Cables in Cabinet

(233)

This consists of the installation of an SDLC Hub along with approximately (8) new SDLC cables. The cables will be routed from the hub to each individual equipment location inside the cabinet. To keep down time of the signal to a minimum, once in place the old existing SDLC cables will be disconnected and new SDLC cables shall be attached as they are plug and play connections.

Remove the existing old SDLC cables all the way back to their connection point. Once the existing has been removed the new SDLC's will be ran in a neat and uniform manner and out of site as much as possible. All wiring shall run to back of cabinet and attached to multiple points so not to be hanging loose. Cables should not be installed in front of equipment, connecting points or components for maintenance purposes.

As a recommendation for cost efficiency, during the minimal flash time of approximately > (2) minutes when the old cables are switched to the new cables, contractors may use the method of stop time in all red and have one person in intersection holding traffic stopped while in flash till the signal is then returned to operation. COL signal technicians will explain this method in detail before start of project.

Installation of Adaptive Signal Equipment in Cabinet

(234)

This consists of relocation and adjustment of some equipment to make room for equipment needed for implementation of adaptive signal system. Typical adjustments within the cabinet may include some or all of the following:

- one or two shelves may need height adjustment to accommodate equipment,
- some panels on the cabinet side wall may need to be moved or relocated,
- one or two cables may need to be re-routed or moved.

After these adjustments, adaptive equipment can be installed, wiring connections can be made appropriately, and new cables / wiring shall be in a neat and uniform manner. Some cabinets may only require installation of new equipment and wiring connections, with few or no adjustments. C.O.L. signal technicians will assist in the layout, adjustment and placement of the equipment in each cabinet location by location.

Installation of Supplied Cable/Wire (235)

City of Longmont staff will at times supply cable such as video camera cable, 5c/7c, 3 pair, and opticom. Contractor shall install cable/wire and make all appropriate connections as per specifications described above, or as directed by Senior Signal Tech/II.

Preventive Maintenance (PM) – Minor and Major (226, 227)

The City of Longmont’s Preventive Maintenance (PM) program performs at least a “Minor” PM at each traffic signal annually and a “Major” PM at each traffic signal about every 4 or 5 years. Major PMs include all work items in a Minor PM, plus additional overhead work items. These guidelines describe pertinent details for work items to be performed on Minor and Major PMs.

City staff will provide a list of intersections each year where Major and or Minor PMs will be assigned to the contractor, and typically they will be assigned on a monthly schedule.

All work tasks to complete PMs shall be inclusive of all labor, equipment and traffic control.

The Contractor shall typically provide the following items, materials and equipment:

- Insect/spider spray, quick drying (spray type) solvent cleaner, powder graphite lubricant and graffiti remover.
- Bandit/buckles, electrical tape both black and colored, rubber tape, tags, zip ties, 3-M connectors, spades, caulking, Buchanan’s / wrap caps, other similar incidental items.

The City shall typically provide the following items, materials and equipment:

- Signal related replacement equipment: Signal/ped heads, visors, pushbuttons, pushbutton stickers, door weather strip seal, locks for doors, LEDs, pull boxes, lids, astro-bracs, SOP ells, backplates, Opticom equipment, MMUs or Smart monitors that have been tested by City staff, etc.

Damaged or Faulty Equipment - The Contractor shall call Signal Operations staff immediately when critical damaged or faulty equipment is discovered that needs immediate attention. At that time City staff will determine action that needs to be taken, and will direct contractor on how to proceed. If non-critical damaged or faulty equipment is discovered, the contractor should document this on the PM Check-Off list. Larger scale repairs will typically be scheduled on a separate work request.

The Contractor should contact Signal Operations staff when there are questions about proper signal equipment operation or damaged / faulty equipment, or if Contractor is unsure whether damage / fault is critical or non-critical, so that City staff can provide clarification or direction. City Signal Operations staff is always available by Cell Phone if not in shop/office.

PM Written Documentation – While on site and at a minimum on a daily basis, the Contractor shall record work completed and comments on the PM Check-Off list as work is being performed on each PM. This helps ensure that information is accurate for each intersection. Documentation shall clearly list all items / equipment that were repaired, replaced, or adjusted. If a work item was not resolved, this shall be documented as a work item that still needs to be addressed.

The Contractor shall turn in Major and Minor PM Check-Off lists on a weekly basis so Signal Operations staff can review the PMs and address any issues or questions in a timely manner after completion of the PM.

Overall Communication with Staff – When each Minor PM is completed, the Contractor shall e-mail the Senior Signal Technician on that day describing which intersection(s) are complete and date/time. If major PM overhead work items are performed separately at night, the contractor shall on a nightly basis send e-mail at the end of the work period describing work performed that night, and which intersections are completed for overhead work. A separate e-mail shall be sent when the daytime Major PM ground level work items are complete.

Major & Minor PM Task Details

Check & Treat Locks & Hinges - Both front and back doors and police panel locks shall first be cleaned with a spray type quick drying solvent cleaner, and then treated with a powder graphite lubricant and working it into the lock mechanism so it is easily turned. Check hinges on front and back door to be sure they are in good working order. If any of the locks are found to be faulty and or getting hard to open and not resolved when treated with the spray then use the one of the spare locks the City provided to you and change it out, when you run out of the spare locks get more from Signal Operations.

Check Door Seals Weather Stripping; Replace Where Needed - Check both the front and back door weather stripping seals. If any portions are found not to be making a proper seal then contractor shall remove and replace as needed. Contractor should replace entire section as in either top, bottom or side; do not piece small sections within top/bottom or sidepieces. City will supply this item as needed. Be sure to ask for more when you run out.

Check for Water Accumulation to Identify Leaks - If any water accumulation is found, Contractor should identify and repair source of leak, and wipe down water accumulation. Contractor should call and notify Signal Ops, so they can return later to check to ensure leak is sealed.

Remove Signs/Tape & Clean Graffiti Off Poles and Cabinet - Remove all signs and tape off poles and cabinet. Also, remove any graffiti from cabinet with a graffiti remover or paint thinner. If there is graffiti that has been covered up by some other spray paint then the entire section of paint shall be removed.

Clean Inside Cabinet Including Power & Back Panel - Contractor should perform a combination of vacuuming, wiping and brushing entire inside of cabinet to get all dirt, spider webs etc. out of cabinet. This includes the back panel under the plastic cover, power panel and under equipment on shelves. If door filter bracket has broken bolts then it shall be repaired during the PM.

Check All Connections, Cables, & Wiring to Ensure Proper Connections - Inside cabinet, check and tighten all terminals to ensure tightness of connection, ensure all solder connections are intact by an in-depth visual and physical touch. Ensure all cables to equipment are secured tightly to equipment/sockets. This also includes our UPS unit connections on the sockets for input/outputs on backside of inverter, where we have UPSs.

Check Operation of All Detection to Verify Proper Operation

Video / Infrared/Thermal -- Use the monitor to visually observe and check operation and placement of zones and camera aim, ensure detection zones are detecting accurately, and verify it is calling the controller properly. (NOTE- On a major PM perform this check after camera cleaning is complete to ensure the camera is clean and has not moved) If a camera is found to be out of the aim/alignment then it is part of the PM to get up and aim it back properly for the zone/detection.

Loop Detection – Loop operation shall first be checked on detector cards, and then checked to verify the calls are going to the controller for proper operation.

If a detector has a stuck recall, reset card to see if it clears. If it clears and appears to stay clear, do a quick test on the detector wiring at the interface panel by wiggling the connection at the panel to see if the detector card red light flickers on and off. If it stays off and remains stable, then no issue. If the detector card red LED light flickers on and off then it may be faulty on either the spade connections or the interface panel. At this point call Signal Ops to get direction on repair. If the red LED light stays on solid and will not clear the stuck call, then investigate loop and splices in pull box or loop valve to see if that may be the cause, this may require ohm'ing out the loop wire. If Contractor cannot resolve after all checks, then call Signal Ops.

Test Opticom Operation & Log Activation Distances - Check controller program to identify Preempt #s and directions that are programmed. Contractor shall drive each direction using an emitter set 8' – 11' above ground level; another person will be at cabinet to watch the activation on both the selector cards and then the progression stages on the controller to verify proper operation.

The test button on the pre-empt selector cards shall not be used to test the operation as this does not hold any value for a test in the field. There should be an activation range of about 2-3 blocks (or about ¼ to ½ mile) away for the beginning of detection on selector card. Log and document the activation ranges for each direction on PM comments. If activation range is less than 1 block call Signal Ops to discuss possible causes. Some possible causes may be resolved on site, such as improper aim of the opticom sensor if it has been twisted by wind or vibration; in which case it will be necessary to go up and adjust it for proper aim. If trees and or other obstacles are found to be blocking the EVP detection, call Signal Ops.

Exchange MMU or Smart monitor with Bench Tested Unit - With every PM the Contractor shall exchange the MMU or Smart monitor in the Cabinet with a unit that has been properly tested. Signal Ops will supply tested units, and the contractor shall return units from cabinets to signal shop as quickly as possible so Signal Ops staff can get them tested and ready for field again.

Verify Proper Flash Operation during MMU or Smart monitor Exchange - While the traffic signal is in Flash Mode during the exchange of the MMU or Smart monitor, the contractor shall observe all intersection approaches to verify proper operation of the FTRs and that no direction is Black.

The City has developed a method for traffic control during the MMU or Smart monitor exchange that has been shown to make it safer for the driving public and the signal technician doing the exchange. It is recommended that City Ops and the contractor discuss this method's steps, and the Contractor consider using it for the traffic control during the exchanges.

Test Pushbuttons and APS units, Verify Proper Operation - All pushbuttons and APS units shall be tested to verify the beep and LED are properly activating and all calls are going to the controller. Pushbuttons shall be tested individually to ensure they are getting proper calls. If a regular pushbutton is not working or has an adaptor broken, the contractor shall change out the pushbutton front section and/or the adaptor as part of the normal PM. If the base section of the pushbutton is damaged and has to be re-drilled/re-set, then call Signal Ops for direction as to when to do this; it may be scheduled for a different time and different work request. APS verbal message and countdown tone shall be verified for proper operation. If any APS units are found to be faulty then call Signal Ops right away for direction on how to repair.

On the adaptive intersections there will be a slightly different protocol that will need to be taken when testing the pushbuttons. Rhythm Engineering will be involved to verify the testing as it happens. COL Signal Operations will give Contractor the details of the testing that will need to be done for each PM.

Check All Pull Boxes at Intersection on Corners - Locate and inspect each pull box, lid and ring for good condition. If covered by dirt, grass, weeds or bushes, then clear off or cut back around pull box and concrete ring. Open the pull box and clean out spider webs, mice nests, weeds,

etc. If a pull box is damaged, too low, high enough to cause a trip hazard, lid is missing or broken, then call Signal Ops for direction. Add rock if needed to meet our specification.

Check color code phase tape and replace if it is missing or fallen off. Spray inside each Pull Box thoroughly with insect repellent. All splices shall be checked for corrosion to ensure good integrity. If any splices are found to be faulty, then change connection to a new Buchanan. If any wire nuts are found on splices, then change out to Buchanan connectors. If any loops are spliced in these pull boxes, they shall be spliced with 3-M connectors. All ground wires shall be checked for secure connection to ground rod and tightened up if needed.

Check Loops and Loop Valves in Roadway - Check all operational loops to verify they are in good working order. Visually inspect all loops in roadway to identify if there are any exposed wires showing; if exposed wires are found, call Signal Ops to get direction on how to proceed. Check the condition of loop valves to determine if they have deteriorated to the point they are not intact or if lid is missing or severely damaged. If the lid is missing or damaged, then clean out valve and install replacement lid. If valve is badly deteriorated, document and inform Signal Ops.

Major PM Additional Task Details

Check All Signal Equipment for Damage - Inspect all signal equipment for damage, including signal heads/mounting hardware, backplates, cameras, opticom, signs, poles/mast arms, etc. If significant damage is found call Signal Ops for direction on how to proceed. If equipment is found to be loose or needs minor adjustment contractor shall adjust, tighten and or straighten as part of the PM task.

Aim & Level Signal Heads and Signs - Level and Aim Signal heads and Signs with a reliable level being sure to only place the level on the side of the signal head not on the astro-brac post. Ensure each signal head is aimed at the appropriate lane it is guiding. Contractor should discuss method for aiming overhead and SOP signal heads with Signal Ops.

Visually Inspect for Exposed or Deteriorating Wiring at Signal Heads and other Equipment - Visually inspect wiring that may be exposed for signal heads (astro-brac assy on wire entrance on lower arm), cameras, and opticom. If any area of the cable/wiring points is found to be

faulty with deteriorating sheathing exposing the copper wiring, then temporarily tape each conductor with the black electrical tape # 88 to keep it from shorting out and notify Signal Ops for direction on how to proceed. This will most likely be scheduled in near future as a re-wire on a separate work order.

Signal Poles/Mast Arms – If hand hole covers are broken or missing, it is part of the PM to get them replaced with spare covers, which will be provided by COL, keep a couple on your PM supplies to use, and when you run low get more from COL. If any of the bolts are broken you will need to get them replaced and possibly re-drill a hole to make it fit properly. When plugging holes that are found in poles/arms the method shall be either using a box plug, which requires a ½” or ¾” NPT tap, or a large washer/spring nut sized to cover the hole and stay in place - then using silicone to seal it to pole/arm. (Take caution as to not catch and crimp any wiring in arms/poles so it does not damage and cause a short in a wire/cable). Any type of filler putty is not acceptable.

If cable has outer sheathing stripped back and conductors are in good shape, then contractor shall first apply rubber tape around entire cable and conductors, and finish up with applying 88 grade black electrical tape over the rubber tape.

Check Advance Loop Pull Boxes - Locate and inspect each pull box, lid and ring for good condition. If covered by dirt, grass, weeds or bushes, then clear off or cut back around pull box and concrete ring. Open the pull box and clean out spider webs, mice nests, weeds, etc. If a pull box is found damaged, too low, high enough to cause a trip hazard, lid is missing or broken, then call Signal Ops for direction. Add rock if needed to meet our specification.

Check color code phase tape and replace if it is missing or fallen off. Spray inside each box thoroughly with the insect repellent. All splices shall be checked for corrosion to ensure good integrity. If any are found to be faulty, then change connection to a new 3-M. If any wire nuts are found on splices, then change out to 3-M connectors. If color code tape has fallen off or missing then put back on the correct color phase tape.

Clean All LEDs, Cameras, and Opticom with Water & Clean Rags - Using only clean plain water in a spray bottle, Contractor shall spray each lens thoroughly and wipe dry using clean rag or towels without leaving a smeared filmy lens. Do not use a dry cloth or towel and dry wipe any LEDs or lens as it scratches the surface.

(NOTE – Cleaning should be performed prior to tests on the Cameras or Opticom)

INSTRUCTIONS

Vendors are required to return one copy of the completed Bid Submittal Documents. It is not necessary to return the Bid documents.

Pricing shall include all parts, materials, equipment, forms, services, disposal fees, fuel surcharges, mileage, labor, utilities, royalties, tools, and any other fees or charges necessary for all of the scheduled service as detailed in the scope of services.